



SEQUENCE LISTING

<110> Cahoon, Rebecca E.  
Hitz, William D.  
Thorpe, Catherine J.  
Tingey, Scott V.

C  
<120> PHYTIC ACID BIOSYNTHETIC ENZYMES

<130> BB1165 US NA

<140> 09/686,522  
<141> 2000-10-11

<150> 60/082,960  
<151> 1998-04-24

<150> PCT/US99/08790  
<151> 1999-04-22

<160> 24

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<212> DNA  
<213> Oryza sativa

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tggcggagga gcagttcctc gccgtcgccg tggacgcccgc caagaacgccc ggcgagatca 180  
tccgcaaggg cttctaccag accaagaacg tggacgacaa gggccaggtg gatttgggtga 240  
cgtagacgga caaggcctgc gaggacctca tcttcaacca cctccggaag cactacccgg 300  
accacaagtt catcgccgag gagacgtccg cggggctcgg cgccaccgcg gacctcacccg 360  
acgaccgcac ctggatcgatc gaccctctcg atggcaccac caatttcgtc catggcttcc 420  
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<210> 2  
<211> 114  
<212> PRT  
<213> Oryza sativa

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Ala Gly Glu Ile Ile Arg Lys Gly Phe Tyr Gln Thr Lys Asn Val Glu  
20 25 30

His Lys Gly Gln Val Asp Leu Val Thr Glu Thr Asp Lys Ala Cys Glu  
35 40 45

Asp Leu Ile Phe Asn His Leu Arg Lys His Tyr Pro Asp His Lys Phe  
50 55 60

Ile Gly Glu Glu Thr Ser Ala Gly Leu Gly Ala Thr Ala Asp Leu Thr  
65 70 75 80

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Asp Asp Pro Thr Trp Ile Val Asp Pro Leu Asp Gly Thr Thr Asn Phe  
85 90 95

Val His Gly Phe Pro Phe Val Cys Val Ser Ile Gly Leu Thr Val Gly  
100 105 110

Lys Ile  
114

<210> 3  
<211> 561  
<212> DNA  
<213> Glycine max

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<222> (556)  
<223> n = a, c, g or t

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tcctcgcatc tgccgtcgac gcggctcaga aagctggcga gattattcga aaaggcttct 180  
accagaccaa aaatgtggaa cacaaaggac aggttgatt ggtcacagaaa actgataaaag 240  
catgtgaaga actcatattt aatcatctga aacagctta tcccactcac aagttcattg 300  
gggaagagac cacagctgcc tatggacta cagaacttac agatgaaccc acatggatat 360  
tgatccctgg atggaactac taacctgtgc atgggttccc tttgtttgtg tcccatggc 420  
tcacaattgg aaaaatctac aattgggtgtt gtatacaatc aatataatga cttttctgga 480  
tcatggaaaaa gtgccttttg atggaatcc ataaatgtct cacaacgann atcagcctct 540  
ctncantgag gnnganaaaaa c 561

<210> 4  
<211> 168  
<212> PRT  
<213> Glycine max

<400> 4  
Met Val Asp Asn Asp Ser Leu Ser Glu Phe Leu Ala Ser Ala Val Asp  
1 5 10 15

Ala Ala Gln Lys Ala Gly Glu Ile Ile Arg Lys Gly Phe Tyr Gln Thr  
20 25 30

Lys Asn Val Glu His Lys Gly Gln Val Asp Leu Val Thr Glu Thr Asp  
35 40 45

Lys Ala Cys Glu Glu Leu Ile Phe Asn His Leu Lys Gln Leu Tyr Pro  
50 55 60

Thr His Lys Phe Ile Gly Glu Glu Thr Thr Ala Ala Tyr Gly Thr Thr  
65 70 75 80

Glu Leu Thr Asp Glu Pro Thr Trp Ile Val Asp Pro Leu Asp Gly Thr  
85 90 95

Thr Asn Phe Val His Gly Phe Pro Phe Val Cys Val Ser Ile Gly Leu  
100 105 110

Thr Ile Gly Lys Thr Pro Thr Ile Gly Val Val Tyr Asn Pro Ile Ile  
115 120 125

Asn Glu Leu Phe Thr Gly Ile His Gly Lys Gly Ala Phe Leu Asn Gly  
130 135 140

Asn Pro Ile Lys Val Ser Ser Gln Thr Glu Leu Ile Ser Ser Leu Leu  
145 150 155 160

Ala Thr Glu Ala Gly Thr Lys Arg  
165

<210> 5  
<211> 667  
<212> DNA  
<213> Glycine max

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cagatttgc aataacatct cagcgagtag cagttcaaa ccctttctaa aaggatgaac 180  
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acaagatagc caacccttgt tagtccgtta accttggcc caaagagttt ttttagattcc 300  
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aaaaaactcc ctaaacatgg gaagaagcac ctccacaggg cacgcgttcc caaacctgg 480  
cgaaaaggcc gtgggcattc gggaaaccgg taccaatcaa ggatcctccc ggaacccaaa 540  
ggcaaggcaa accgcggcac gggcttgggc caaaccgg tgaaccgccc cccaccaacg 600  
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<210> 6  
<211> 73  
<212> PRT  
<213> Glycine max

<220>  
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<222> (56)  
<223> Xaa = any amino acid

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1 5 10 15

Pro Trp Asp Val Ala Gly Gly Ala Val Ile Val Arg Glu Ala Gly Gly  
20 25 30

Val Val Phe Asp Pro Ser Gly Ala Asp Phe Ala Ile Thr Ser Gln Arg  
35 40 45

Val Ala Val Ser Asn Pro Phe Xaa Lys Asp Glu Leu Val Glu Thr Arg  
50 55 60

Arg Lys Met Gly Trp Glu Ile Tyr Asn  
65 70

<210> 7

<211> 1003

<212> DNA

<213> Triticum aestivum

<400> 7

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agggccaggt ggatttggtg acggagacgg acaaggcatg cgaggatctc atcttcaacc 180  
acctccggat gctctacccg gaccacaagt tcatacgccga ggagacgtct gcagccctcg 240  
gctccaccga tgacccatc tacgacccca cctggatagt cgaccccctc gatggcacca 300  
ccaacttcgt tcatggctt cctttgtgt gcgtctcgat tggcctcacc attgggaaga 360  
ttcccaccgt tggagttgtg tacaacccca tcatgaatga gctttcaca gctgttcgtg 420  
gaaaaggtgc ttttctcaat ggctctccaa ttaaaaacatc gcctcaaaat gagttggta 480  
aggctcttat ggtgacagag gtagggacca aaagagacaa gtccactttg gatgatacaa 540  
ccaacagaat taataagtta ctattcaaga ttagatctat acgtatgtgt ggctctttgg 600  
ctctaaacat gtgtggagtt gcttgtggta ggcttagatt gtgttatgag atcggttttg 660  
gtggccctg ggatgtggct gctggagctt tgattctaaa ggaagctggg ggtttgttt 720  
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acctcaagga tcagttcatc aaagcattgg gagatgcaag ctgaataact tatttctctt 840  
ttcaagtaga atgaaagaat gtaagatggc cccaccaata agtaattgag ggctacttt 900  
tgtgttagttc tatatgcata tttgcaaac gtggcgatg taatgacatt ggatatattg 960  
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<210> 8

<211> 267

<212> PRT

<213> Triticum aestivum

<400> 8

Met Ala Glu Glu Gln Phe Leu Ala Ala Ala Val Gly Ala Ala Lys Ser  
1 5 10 15

Ala Gly Glu Ile Ile Arg Lys Ser Phe Tyr Leu Ser Lys Lys Val Glu  
20 25 30

His Lys Gly Gln Val Asp Leu Val Thr Glu Thr Asp Lys Ala Cys Glu  
35 40 45

Asp Leu Ile Phe Asn His Leu Arg Met Leu Tyr Pro Asp His Lys Phe  
50 55 60

Ile Gly Glu Glu Thr Ser Ala Ala Leu Gly Ser Thr Asp Asp Leu Thr  
65 70 75 80

Tyr	Asp	Pro	Thr	Trp	Ile	Val	Asp	Pro	Leu	Asp	Gly	Thr	Thr	Asn	Phe
					85				90						95
Val	His	Gly	Phe	Pro	Phe	Val	Cys	Val	Ser	Ile	Gly	Leu	Thr	Ile	Gly
					100			105							110
Lys	Ile	Pro	Thr	Val	Gly	Val	Val	Tyr	Asn	Pro	Ile	Met	Asn	Glu	Leu
					115			120							125
Phe	Thr	Ala	Val	Arg	Gly	Lys	Gly	Ala	Phe	Leu	Asn	Gly	Ser	Pro	Ile
					130			135							140
Lys	Thr	Ser	Pro	Gln	Asn	Glu	Leu	Val	Lys	Ala	Leu	Met	Val	Thr	Glu
					145			150			155				160
Val	Gly	Thr	Lys	Arg	Asp	Lys	Ser	Thr	Leu	Asp	Asp	Thr	Thr	Asn	Arg
					165			170							175
Ile	Asn	Lys	Leu	Leu	Phe	Lys	Ile	Arg	Ser	Ile	Arg	Met	Cys	Gly	Ser
					180			185							190
Leu	Ala	Leu	Asn	Met	Cys	Gly	Val	Ala	Cys	Gly	Arg	Leu	Asp	Leu	Cys
					195			200							205
Tyr	Glu	Ile	Gly	Phe	Gly	Gly	Pro	Trp	Asp	Val	Ala	Ala	Gly	Ala	Leu
					210			215							220
Ile	Leu	Lys	Glu	Ala	Gly	Gly	Phe	Val	Phe	Asp	Pro	Ser	Gly	Asp	Glu
					225			230			235				240
Phe	Asp	Leu	Met	Ala	Gln	Arg	Met	Ala	Gly	Ser	Asn	Gly	His	Leu	Lys
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Asp	Gln	Phe	Ile	Lys	Ala	Leu	Gly	Asp	Ala	Ser					
					260			265							

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 <211> 1090  
 <212> DNA  
 <213> Hordeum vulgare

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 gtgcattgat ccttagatg gaacaacaaa ctgtcacat gtttaccca gctttctgt 180  
 atccatgggt gttctttatc gaggcaagcc tgctgctgcc actgtgggtgg aattttgtgg 240  
 tgggcctatg tgctggagca ctcgtacaat ttctgcatact tctggcaaag gtgcttattg 300  
 taatggcaa aaaattcatg tcagtccaa acagaaagggtg gaacagtctc ttctggtaac 360  
 tgggtttggaa tatgaacatg atgatgcata gctcaccaat ataaatttgt tcaaggaatt 420  
 tactgatgtt agcaggggag tacgaaggct aggctctgtc gctgccata tgtccatgt 480  
 tggcttaggc attacagaag cctactggaa atatcggttt aagccgtgg acatggctgc 540  
 tggcggtctg atagttgaag aagctgggtgg agtagtgaca cgcattggatg gtggggagtt 600  
 tacagtctt gatcggtctg ttcttggttc caatggcgat gttcatgatc agcttttggaa 660  
 gcggatccgg cctgctactg aagatcttaa gaagaaagga attgatttct cttgtggtt 720  
 taagcctgac aagtacccta ccgacttctg aatcacgctg ctcttcagct acttggcttc 780  
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 ttcaagaccc ttctactcaa ccggatcgaa aattaaagcc gaactttaca taaaggagta 900  
 gagctcgaat gagcttctca ctggattcct tttgcttga tcgaatgtat caggaagaaa 960  
 tgtttgcaaa aggtgttgta tgcattggttc cagcctgttg tacttgaaaa aatataactg 1020  
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1090

<210> 10

<211> 249

<212> PRT

<213> Hordeum vulgare

<400> 10

His Glu Asp Lys Leu Ser Glu Ser Val Ile Leu Glu Val Val Thr Lys  
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Asn Phe Arg Asp His Leu Ile Leu Gly Glu Glu Gly Gly Leu Ile Gly  
20 25 30

Asp Ser Leu Ser Glu Tyr Leu Trp Cys Ile Asp Pro Leu Asp Gly Thr  
35 40 45

Thr Asn Phe Ala His Gly Tyr Pro Ser Phe Ser Val Ser Ile Gly Val  
50 55 60

Leu Tyr Arg Gly Lys Pro Ala Ala Ala Thr Val Val Glu Phe Cys Gly  
65 70 75 80

Gly Pro Met Cys Trp Ser Thr Arg Thr Ile Ser Ala Ser Ser Gly Lys  
85 90 95

Gly Ala Tyr Cys Asn Gly Gln Lys Ile His Val Ser Pro Thr Glu Lys  
100 105 110

Val Glu Gln Ser Leu Leu Val Thr Gly Phe Gly Tyr Glu His Asp Asp  
115 120 125

Ala Trp Leu Thr Asn Ile Asn Leu Phe Lys Glu Phe Thr Asp Val Ser  
130 135 140

Arg Gly Val Arg Arg Leu Gly Ser Ala Ala Asp Met Ser His Val  
145 150 155 160

Gly Leu Gly Ile Thr Glu Ala Tyr Trp Glu Tyr Arg Leu Lys Pro Trp  
165 170 175

Asp Met Ala Ala Gly Val Leu Ile Val Glu Glu Ala Gly Gly Val Val  
180 185 190

Thr Arg Met Asp Gly Gly Glu Phe Thr Val Phe Asp Arg Ser Val Leu  
195 200 205

Val Ser Asn Gly Val Val His Asp Gln Leu Leu Glu Arg Ile Arg Pro  
210 215 220

Ala Thr Glu Asp Leu Lys Lys Gly Ile Asp Phe Ser Leu Trp Phe  
225 230 235 240

Lys Pro Asp Lys Tyr Pro Thr Asp Phe  
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<210> 11

<211> 989

<212> DNA

<213> Zea mays

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aaaaaaaaatg atggctgctt tattatggtg gccaatggct ggtgggtgg 180  
agctcaaaag tcagtcgggt acttgtcagg cttgaaccac aacgagaagt cgatcccttt 240  
cttctaagg tcttcagtag gagggccgat ccggtccaaa agctgtccac acagacaaca 300  
ctaagaacaa aacctgtcca tgaacgccac aaacaatatg ccaaattgtt cacaacaaac 360  
aacacctgtcc atgaacaagt ccgttgaaa caagaacaga gcgatcgaaag accgtaaact 420  
ctccaccgtc catgcgagtt accaccccac cagcttcctc tactatcagg acgccagcat 480  
gcacatccca tggcttaagt cggtattccc agtaagcttc tgtaatacca agtccaatgt 540  
gggacatgtc agcagcagca gacccgagcc ttgcgcactcc cctgctaatt tcagtaaatt 600  
ccttgaacag attcatattg gtcgtccagg catcatcg 660  
cgagaagtga ttgttccacc ttgtctgtct gactgacatg aatcctttgt ccaatataat 720  
aagctcctcc gccagcaa 780  
aaaattctca cccacttgaa accacacggg ttttcccagg aaagaacaac taatggcaca 840  
gttaaaccg ggggtaccat tggcaaagtt cttgtctcc accaaagggt aattgcccc 900  
aaggctcct gaaaggaa 960  
tttaattct ttggggaaaa tctcaaaag 989

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<211> 136  
<212> PRT  
<213> Zea mays

<400> 12  
Met Cys Trp Thr Thr Arg Thr Ile Phe Pro Phe Ala Gly Gly Gly Ala  
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Tyr Tyr Ile Gly Gln Arg Ile His Val Ser Gln Thr Asp Lys Val Glu  
20 25 30  
  
Gln Ser Leu Leu Val Thr Gly Phe Gly Tyr Glu His Asp Asp Ala Trp  
35 40 45  
  
Thr Thr Asn Met Asn Leu Phe Lys Glu Phe Thr Asp Ile Ser Arg Gly  
50 55 60  
  
Val Arg Arg Leu Gly Ser Ala Ala Ala Asp Met Ser His Ile Gly Leu  
65 70 75 80  
  
Gly Ile Thr Glu Ala Tyr Trp Glu Tyr Arg Leu Lys Pro Trp Asp Val  
85 90 95  
  
His Ala Gly Val Leu Ile Val Glu Glu Ala Gly Gly Val Val Thr Arg  
100 105 110  
  
Met Asp Gly Gly Glu Phe Thr Val Phe Asp Arg Ser Val Leu Val Ser  
115 120 125  
  
Asn Gly Leu Val His Gly Gln Val  
130 135

<210> 13  
<211> 492  
<212> DNA  
<213> Zea mays

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<222> .(351)

<223> n = a, c, g or t

<220>

<221> unsure

<222> (442)

<223> n = a, c, g or t

<220>

<221> unsure

<222> (485)

<223> n = a, c, g or t

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cctcgctcc gcaaacccta acccccgctc tcgcctcctc cgccctcgcg ccgcctcgcc 180  
cgtgtcgtcc gcgggtcttga gcgcgagtgg ggcgcagccg atgagtagcg tttagggcctc 240  
gttcgcgcgt ggggcggccg gcccggagagc tgccggcagtg ggggagttgg cgacggagcg 300  
gctggtgagg gtggcgcaac gggcggcgga cgctgctggg gaggtgctca nagaactt 360  
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<210> 14

<211> 338

<212> PRT

<213> Zea mays

<400> 14

Met Leu Ser Ser Ser Ser Thr His Ser Asp Thr Ser Pro Phe Pro  
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20 25 30

Arg Ala Ala Ser Pro Val Ser Ser Ala Val Leu Ser Ala Ser Gly Arg  
35 40 45

Gln Pro Met Ser Thr Val Arg Ala Ser Phe Ala Ala Gly Ala Ala Gly  
50 55 60

Arg Arg Ala Ala Ala Val Gly Glu Leu Ala Thr Glu Arg Leu Val Glu  
65 70 75 80

Val Ala Gln Arg Ala Ala Asp Ala Ala Gly Glu Val Leu Arg Lys Tyr  
85 90 95

Phe Arg Gln Arg Val Glu Ile Ile Asp Lys Glu Asp His Ser Pro Val  
100 105 110

Thr Ile Ala Asp Arg Glu Ala Glu Glu Ala Met Val Ser Val Ile Leu  
115 120 125

Lys Ser Phe Pro Thr His Ala Ile Phe Gly Glu Glu Asn Gly Trp Arg  
130 135 140

Cys Ala Glu Asn Ser Ala Asp Phe Val Trp Val Leu Asp Pro Ile Asp  
145 150 155 160

Gly Thr Lys Ser Phe Ile Thr Gly Lys Pro Leu Phe Gly Thr Leu Ile  
165 170 175

Ala Leu Leu His Asn Gly Lys Pro Val Ile Gly Val Ile Asp Gln Pro  
180 185 190

Ile Leu Arg Glu Arg Trp Ile Gly Val Asp Gly Lys Gln Thr Thr Leu  
195 200 205

Asn Gly Gln Glu Ile Ser Val Arg Ser Cys Asn Leu Leu Ala Gln Ala  
210 215 220

Tyr Leu Tyr Thr Thr Ser Pro His Leu Phe Glu Ala Asp Ala Glu Asp  
225 230 235 240

Ala Phe Ile Arg Val Arg Asn Lys Val Lys Val Pro Leu Tyr Gly Cys  
245 250 255

Asp Cys Tyr Ala Tyr Ala Leu Leu Ala Ser Gly Phe Val Asp Ile Val  
260 265 270

Val Glu Ser Gly Leu Lys Pro Tyr Asp Phe Leu Ser Leu Val Pro Val  
275 280 285

Ile Glu Gly Ala Gly Gly Ser Ile Thr Asp Trp Arg Gly Asp Lys Leu  
290 295 300

His Trp Pro Val Thr Ala Glu Ser Arg Pro Thr Ser Phe Asn Val Val  
305 310 315 320

Ala Ala Gly Asp Ala Arg Val His Lys Glu Ala Leu Asp Ala Leu Arg  
325 330 335

Trp Arg

<210> 15

<211> 593

<212> DNA

<213> Oryza sativa

<400> 15

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acgaagacta ggttctgctg ctgctgacat gtcccacgtt gccctaggca ttacagaagc 180  
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agctggtggg atgggttcac gcatggatgg tgggagttt accgtctttg atcggtctgt 300  
ccttggttcc aatgggttg tacatgatca gctttggat cggattggcc ctgccacaga 360  
agatcttaag aagaaaggaa ttgatttctc cttgtgggtt aaacccgaca aataccctac 420  
cgactttaa gttgaactcc tcacccagag ctatttata ctactagaag aaaagagaaa 480  
aacagaggat cttatgttaa aatgccatgt acttgactga atatttggttt attgaagtcc 540  
tttgactcaa aaaaaaaaaa aaaaaaaaaac tcgagggggg gccggcacac aat 593

<210> 16

<211> 142

<212> PRT

<213> Oryza sativa

<400> 16

His Glu Leu Thr Lys Val Glu Gln Ser Leu Leu Val Thr Gly Phe Gly

1 . . . . . 5 10 15

Tyr Glu His Asp Asp Ala Trp Val Thr Asn Ile Asn Leu Phe Lys Glu  
20 25 30

Tyr Thr Asp Ile Ser Arg Gly Val Arg Arg Leu Gly Ser Ala Ala Ala  
35 40 45

Asp Met Ser His Val Ala Leu Gly Ile Thr Glu Ala Tyr Trp Glu Tyr  
50 55 60

Arg Leu Lys Pro Trp Asp Met Ala Ala Gly Val Leu Ile Val Glu Glu  
65 70 75 80

Ala Gly Gly Met Val Ser Arg Met Asp Gly Gly Glu Phe Thr Val Phe  
85 90 95

Asp Arg Ser Val Leu Val Ser Asn Gly Val Val His Asp Gln Leu Leu  
100 105 110

Asp Arg Ile Gly Pro Ala Thr Glu Asp Leu Lys Lys Lys Gly Ile Asp  
115 120 125

Phe Ser Leu Trp Phe Lys Pro Asp Lys Tyr Pro Thr Asp Phe  
130 135 140

<210> 17

<211> 1103

<212> DNA

<213> Glycine max

<400> 17

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tcggtaacaa agtcggccat gctgcccggag aagtatccg caaatacttc agaaaaaaact 180  
tcgacgttat tcacaaacat gatctcagtc cagtaaccat tgcatcgaa tctgctgagg 240  
aggctatggt ttcaatcata ctagacaatt tcccttctca tgccatttac ggagaggaaa 300  
atgggtggag gtgtgaagaa aagaatgctg attatgttg ggtatttagat cccatagatg 360  
ggactaagag ctttattact gggaaacctg tatttggatc tctcggtgct cttctacaaa 420  
atggcacacc aatccttggc ataattgatc aacctgtgtt aagagaaagg tggatcggga 480  
tagcaggaaa gagaacctca ctgaacggac aagaaatatc tacacgcact tgtcgccacc 540  
tttctcaagc atacctgtac accacaagcc cacatctgtt caatggagat gcagaagaag 600  
cattcattcg tggatcggc aaggtaaat tccaattgtt tggctgcac tgctatgc 660  
atgcacttt gtcttctgg tttgtggatc ttgttgttga gtctggctg aagccatacg 720  
attttcttgc attgattcct gttattgaag gcgctggagg tgtcataact gattggaaag 780  
gagataaaact gtttggaa gcttctccac tttcaatcg cacaagttt aatgttgtgg 840  
ctgctggatc caaacagatt catcaacaag ctctagattc attgcagtgg aagtgtatgc 900  
ttgaattaat cttcagtgc aataatctt tctgcaaattgt gtcttgattc agatgttgc 960  
aaggacatgt attaccgtac cattttctgg catttaagtt gaaaaccatg tactcagaat 1020  
cttgaataag ttcctgcaga aattaacctc tttgtctatt ggttgtaaa aaaagggggg 1080  
gccgtacaaa tctccccggcc ccg 1103

<210> 18

<211> 295

<212> PRT

<213> Glycine max

<400> 18

Met Phe Ser Gln Cys His Phe Leu Ser His Ser Pro Ile Pro Asn Thr  
1 5 10 15

Thr Phe Arg Leu Arg Ala Met Ala Pro His Ser Thr Pro Leu Glu Leu  
20 25 30

Asn Arg Phe Ala Glu Val Gly Asn Lys Val Ala Asp Ala Ala Gly Glu  
35 40 45

Val Ile Arg Lys Tyr Phe Arg Lys Asn Phe Asp Val Ile His Lys His  
50 55 60

Asp Leu Ser Pro Val Thr Ile Ala Asp Gln Ser Ala Glu Glu Ala Met  
65 70 75 80

Val Ser Ile Ile Leu Asp Asn Phe Pro Ser His Ala Ile Tyr Gly Glu  
85 90 95

Glu Asn Gly Trp Arg Cys Glu Glu Lys Asn Ala Asp Tyr Val Trp Val  
100 105 110

Leu Asp Pro Ile Asp Gly Thr Lys Ser Phe Ile Thr Gly Lys Pro Val  
115 120 125

Phe Gly Thr Leu Val Ala Leu Leu Gln Asn Gly Thr Pro Ile Leu Gly  
130 135 140

Ile Ile Asp Gln Pro Val Leu Arg Glu Arg Trp Ile Gly Ile Ala Gly  
145 150 155 160

Lys Arg Thr Ser Leu Asn Gly Gln Glu Ile Ser Thr Arg Thr Cys Ala  
165 170 175

Asp Leu Ser Gln Ala Tyr Leu Tyr Thr Ser Pro His Leu Phe Asn  
180 185 190

Gly Asp Ala Glu Glu Ala Phe Ile Arg Val Arg Ser Lys Val Lys Phe  
195 200 205

Gln Leu Tyr Gly Cys Asp Cys Tyr Ala Tyr Ala Leu Leu Ser Ser Gly  
210 215 220

Phe Val Asp Leu Val Val Glu Ser Gly Leu Lys Pro Tyr Asp Phe Leu  
225 230 235 240

Ala Leu Ile Pro Val Ile Glu Gly Ala Gly Gly Val Ile Thr Asp Trp  
245 250 255

Lys Gly Asp Lys Leu Phe Trp Glu Ala Ser Pro Leu Ser Ile Ala Thr  
260 265 270

Ser Phe Asn Val Val Ala Ala Gly Asp Lys Gln Ile His Gln Gln Ala  
275 280 285

Leu Asp Ser Leu Gln Trp Lys  
290 295

<210> 19  
<211> 1418  
<212> DNA  
<213> Triticum aestivum

<400> .19

gcacgagaca aaaccttagcc tcccttacca cctccgctcg ccctccctcc tggcaacctt 60  
ctcctcctcc gcggcgggtc gggcctgcgg gatacgggc cgttggatgg gctcggttcg 120  
agcctcgccc tctgaggcgg ggggctggc ggtgctgcg gcggtaagg agggggtgga 180  
catggagcgg ctggtggcgg tggcgcagag cgcggcggat gcggcggggg aggtgctcag 240  
gaagtacttc aggcaagcgct tcgagatcat cgacaaagag gaccacagtc ccgtcacat 300  
cgctgataga gaagcagaag aagcaatgac ctcagtcata ctgaagagct ttccctactca 360  
tgctgtttc ggtgaggaga acggttggag gtgtgcagag aagtctgctg actatgtttg 420  
gtcttggac cccatagatg gaacaaagag cttcataact gggaaagcctc ttttggtag 480  
gcttattgcg cttcttcaca atggaaagcc ggatatggc attattgatc agccaatctt 540  
gagagagaga tgggttgggg tggacggaa gaaaactacc ttaaatggac aagaaatatc 600  
tgtccgtcct tgcaatgtac tggagcaagc ttacttata actacgagtc cacatctt 660  
tgaaggagat gctgaagatg cattcattcg tgtacgagac aagtgaaag tcccattgta 720  
tggctgtgat tgttatgctt atgctctcct ggcttctgg tttgtggatc ttgtgtttga 780  
atctggattg aagccatacg attttctctc gctgttaccg gtgattgaag gagctggggg 840  
ctcaataact gattggaaag ggaacaagct ccactggcct gtctcttcgg aatctcgcc 900  
aacaagttc aacgtggtgg cagccggaga ttcccatgtc catggcagg ccctggcagc 960  
gttgcgggtgg cgcttagcctg cctgcagcac gggcggcctt ctattgttca ttttagaaggc 1020  
tgcaactgtt attcatctat ccaataaaac tgagtctgta cgcttcctca gtgggtaaag 1080  
caagttgttc acggtgcacc cttaactcaa taatgatcag tggtttctt tttgtgttta 1140  
aaaaaaaaaaa aaaaaaaaaaa aaaaaaaaaaa aaaaaaaaaaa aaaaaaaaaaa aaaaaaaaaaa 1200  
aaaaaaaaaaa aaaaaacaaa aaaaaaaaata aaaaaaaaaaa aaaacccccg gggggggggc 1260  
ggggacccaaa ttccccata tttttttt ttttaccccc ccccaggggg gttttttta 1320  
taaaactct gaggggggaa aaaccggggg tttaacccaa taaatcccct tgaacaaaaa 1380  
cccccttcc ccaagggggg taataaaaaa aaggcccg 1418

<210> 20

<211> 324

<212> PRT

<213> Triticum aestivum

<400> 20

His Glu Thr Lys Pro Ser Leu Pro Tyr His Leu Arg Ser Pro Ser Leu  
1 5 10 15

Leu Ala Thr Phe Ser Ser Ser Ala Ala Gly Arg Ala Cys Gly Ile Ala  
20 25 30

Gly Arg Trp Met Gly Ser Val Arg Ala Ser Pro Ser Glu Ala Gly Gly  
35 40 45

Trp Ala Val Ala Ala Ala Gly Lys Glu Gly Val Asp Met Glu Arg Leu  
50 55 60

Val Ala Val Ala Gln Ser Ala Ala Asp Ala Ala Gly Glu Val Leu Arg  
65 70 75 80

Lys Tyr Phe Arg Gln Arg Phe Glu Ile Ile Asp Lys Glu Asp His Ser  
85 90 95

Pro Val Thr Ile Ala Asp Arg Glu Ala Glu Glu Ala Met Thr Ser Val  
100 105 110

Ile Leu Lys Ser Phe Pro Thr His Ala Val Phe Gly Glu Glu Asn Gly  
115 120 125

Trp Arg Cys Ala Glu Lys Ser Ala Asp Tyr Val Trp Val Leu Asp Pro  
130 135 140

Ile Asp Gly Thr Lys Ser Phe Ile Thr Gly Lys Pro Leu Phe Gly Thr

145 . . . . . 150 . . . . . 155 . . . . . 160 . . . . .  
Leu Ile Ala Leu Leu His Asn Gly Lys Pro Val Met Gly Ile Ile Asp  
165 . . . . . 170 . . . . . 175 . . . . .  
Gln Pro Ile Leu Arg Glu Arg Trp Val Gly Val Asp Gly Lys Lys Thr  
180 . . . . . 185 . . . . . 190 . . . . .  
Thr Leu Asn Gly Gln Glu Ile Ser Val Arg Pro Cys Asn Val Leu Glu  
195 . . . . . 200 . . . . . 205 . . . . .  
Gln Ala Tyr Leu Tyr Thr Thr Ser Pro His Leu Phe Glu Gly Asp Ala  
210 . . . . . 215 . . . . . 220 . . . . .  
Glu Asp Ala Phe Ile Arg Val Arg Asp Lys Val Lys Val Pro Leu Tyr  
225 . . . . . 230 . . . . . 235 . . . . . 240 . . . . .  
Gly Cys Asp Cys Tyr Ala Tyr Ala Leu Leu Ala Ser Gly Phe Val Asp  
245 . . . . . 250 . . . . . 255 . . . . .  
Leu Val Val Glu Ser Gly Leu Lys Pro Tyr Asp Phe Leu Ser Leu Val  
260 . . . . . 265 . . . . . 270 . . . . .  
Pro Val Ile Glu Gly Ala Gly Ser Ile Thr Asp Trp Glu Gly Asn  
275 . . . . . 280 . . . . . 285 . . . . .  
Lys Leu His Trp Pro Val Ser Ser Glu Ser Arg Pro Thr Ser Phe Asn  
290 . . . . . 295 . . . . . 300 . . . . .  
Val Val Ala Ala Gly Asp Ser His Val His Gly Gln Ala Leu Ala Ala  
305 . . . . . 310 . . . . . 315 . . . . . 320 . . . . .  
Leu Arg Trp Arg

<210> 21  
<211> 273  
<212> PRT  
<213> Lycopersicon esculentum  
  
<400> 21  
Met Ala Arg Asn Gly Ser Leu Glu Glu Phe Leu Gly Val Ala Val Asp  
1 . . . . . 5 . . . . . 10 . . . . . 15 . . . . .  
Ala Ala Lys Arg Ala Gly Glu Ile Ile Arg Lys Gly Phe His Glu Thr  
20 . . . . . 25 . . . . . 30 . . . . .  
Lys His Val Val His Lys Gly Gln Val Asp Leu Val Thr Glu Thr Asp  
35 . . . . . 40 . . . . . 45 . . . . .  
Lys Ala Cys Glu Asp Leu Ile Phe Asn His Leu Lys Gln His Phe Pro  
50 . . . . . 55 . . . . . 60 . . . . .  
Ser His Lys Phe Ile Gly Glu Glu Thr Ser Ala Ala Thr Gly Asp Phe  
65 . . . . . 70 . . . . . 75 . . . . . 80 . . . . .  
Asp Leu Thr Asp Glu Pro Thr Trp Ile Val Asp Pro Val Asp Gly Thr  
85 . . . . . 90 . . . . . 95 . . . . .  
Thr Asn Phe Val His Gly Phe Pro Ser Val Cys Val Ser Ile Gly Leu

100                    105                    110

Thr Ile Gly Lys Ile Pro Thr Val Gly Val Val Tyr Asp Pro Ile Ile  
115                    120                    125

Asp Glu Leu Phe Thr Gly Ile Asn Gly Lys Gly Ala Tyr Leu Asn Gly  
130                    135                    140

Lys Pro Ile Lys Val Ser Ser Gln Ser Glu Leu Val Lys Ser Leu Leu  
145                    150                    155                    160

Gly Thr Glu Val Gly Thr Thr Arg Asp Asn Leu Thr Val Glu Thr Thr  
165                    170                    175

Thr Arg Arg Ile Asn Asn Leu Leu Phe Lys Val Arg Ser Leu Arg Met  
180                    185                    190

Cys Gly Ser Cys Ala Leu Asp Leu Cys Trp Val Ala Cys Gly Arg Leu  
195                    200                    205

Glu Leu Phe Tyr Leu Ile Gly Tyr Gly Gly Pro Trp Asp Val Ala Gly  
210                    215                    220

Gly Ala Val Ile Val Lys Glu Ala Gly Gly Val Leu Phe Asp Pro Ser  
225                    230                    235                    240

Gly Ser Glu Phe Asp Ile Thr Ser Gln Arg Val Ala Ala Thr Asn Pro  
245                    250                    255

His Leu Lys Glu Ala Phe Val Glu Ala Leu Gln Leu Ser Glu Tyr Val  
260                    265                    270

Ser

<210> 22  
<211> 268  
<212> PRT  
<213> Lycopersicon esculentum

<400> 22  
Met Ala Gln Asn Gly Ser Val Glu Gln Phe Leu Asp Val Ala Val Glu  
1                    5                    10                    15

Ala Ala Lys Lys Ala Gly Glu Ile Ile Arg Glu Gly Phe Tyr Lys Thr  
20                    25                    30

Lys His Val Glu His Lys Gly Met Val Asp Leu Val Thr Glu Thr Asp  
35                    40                    45

Lys Ala Cys Glu Asp Phe Ile Phe Asn His Leu Lys Gln Arg Phe Pro  
50                    55                    60

Ser His Lys Phe Ile Gly Glu Glu Thr Thr Ala Ala Cys Gly Asn Phe  
65                    70                    75                    80

Glu Leu Thr Asp Glu Pro Thr Trp Ile Val Asp Pro Leu Asp Gly Thr  
85                    90                    95

Thr Asn Phe Val His Gly Phe Pro Phe Val Cys Val Ser Ile Gly Leu

100                    105                    110

Thr Ile Glu Lys Lys Pro Thr Val Gly Val Val Tyr Asn Pro Ile Ile  
115                    120                    125

Asp Glu Leu Phe Thr Gly Ile Asp Gly Lys Gly Ala Phe Leu Asn Gly  
130                    135                    140

Lys Pro Ile Lys Val Ser Ser Gln Ser Glu Leu Val Lys Ala Leu Leu  
145                    150                    155                    160

Ala Thr Glu Ala Gly Thr Asn Arg Asp Lys Leu Val Val Asp Ala Thr  
165                    170                    175

Thr Gly Arg Ile Asn Ser Leu Leu Phe Lys Val Arg Ser Leu Arg Met  
180                    185                    190

Cys Gly Ser Cys Ala Leu Asn Leu Cys Gly Val Ala Cys Gly Arg Leu  
195                    200                    205

Asp Leu Phe Tyr Glu Leu Glu Phe Gly Gly Pro Trp Asp Val Ala Gly  
210                    215                    220

Gly Ala Val Ile Val Lys Glu Ala Gly Gly Phe Val Phe Asp Pro Ser  
225                    230                    235                    240

Gly Ser Glu Phe Asp Leu Thr Ala Arg Arg Val Ala Ala Thr Asn Ala  
245                    250                    255

His Leu Lys Asp Ala Phe Ile Lys Ala Leu Asn Glu  
260                    265

<210> 23  
<211> 287  
<212> PRT  
<213> Synechocystis sp.

<400> 23  
Met Thr Ser Ala Gln Lys Pro Val Phe Ser Pro Ser Asp Leu Gln Thr  
1                    5                    10                    15

Trp Leu Glu Ile Ala Thr Glu Ala Val Leu Ala Ala Gly Ala Glu Ile  
20                    25                    30

Phe Ser Leu Trp Gly Lys Val Gln Gln Ile Gln Glu Lys Gly Arg Ala  
35                    40                    45

Gly Asp Leu Val Thr Glu Ala Asp Arg Gln Ala Glu Ala Ile Ile Leu  
50                    55                    60

Glu Ile Ile Lys Arg Arg Cys Pro Asp His Ala Ile Leu Ala Glu Glu  
65                    70                    75                    80

Ser Gly Gln Leu Gly Gln Val Asp Asn Pro Phe Cys Trp Ala Ile Asp  
85                    90                    95

Pro Leu Asp Gly Thr Thr Asn Phe Ala His Ser Tyr Pro Val Ser Cys  
100                    105                    110

Val Ser Ile Gly Leu Leu Ile Gln Asp Ile Pro Thr Val Gly Val Val

115	120	125	
Tyr Asn Pro Phe Arg Gln Glu	Leu Phe Arg Ala Ala Thr Ser Leu Gly		
130	135	140	
Ala Thr Leu Asn Arg Arg Pro Ile Gln Val Ser Thr Thr Ala Ser Leu			
145	150	155	160
Asp Lys Ser Leu Leu Val Thr Gly Phe Ala Tyr Asp Arg Val Lys Thr			
165	170	175	
Leu Asp Asn Asn Tyr Pro Glu Phe Cys Tyr Leu Thr His Leu Thr Gln			
180	185	190	
Gly Val Arg Arg Ser Gly Ser Ala Ala Ile Asp Leu Ile Asp Val Ala			
195	200	205	
Cys Gly Arg Leu Asp Gly Tyr Trp Glu Arg Gly Ile Asn Pro Trp Asp			
210	215	220	
Met Ala Ala Gly Ile Val Ile Val Arg Glu Ala Gly Gly Ile Val Ser			
225	230	235	240
Ala Tyr Asp Cys Ser Pro Leu Asp Leu Ser Thr Gly Arg Ile Leu Ala			
245	250	255	
Thr Asn Gly Lys Ile His Gln Glu Leu Ser Gln Ala Leu Ala Ala Thr			
260	265	270	
Pro Gln Trp Phe Gln Gln Tyr Ala Ala Ala Arg Ala Gln Lys Ile			
275	280	285	
<210> 24			
<211> 267			
<212> PRT			
<213> Synechocystis sp.			
<400> 24			
Met Leu Pro Glu Val Glu Gln Arg Leu Phe Ile Ala Gln Gln Leu Ala			
1	5	10	15
Ala Val Ser Gly Glu Ile Leu Ile Gln Tyr Phe Arg Arg Ser His Leu			
20	25	30	
Gln Gly Gly Thr Lys Ile Asp Gln Val Ser Ala Ile Val Thr Gln Ala			
35	40	45	
Asp Glu Glu Ala Glu Gln Ala Met Val Asp Leu Ile Gln Ala Gln Phe			
50	55	60	
Pro Gln Asp Gly Val Ile Arg Glu Glu Gly Lys Asn Ile Ala Gly Lys			
65	70	75	80
Ser Gly Tyr Thr Trp Val Leu Asp Pro Ile Asp Gly Thr Ser Ser Phe			
85	90	95	
Val Arg Gly Leu Pro Ile Phe Ala Thr Leu Ile Gly Leu Val Asp Ala			
100	105	110	
Asp Met Arg Pro Val Leu Gly Ile Ala His Gln Pro Ile Ser Gly Asp			

^ 115                    120                    125

Arg Trp Gln Gly Val Gln Gly Glu Gln Ser Asn Val Asn Gly Ile Pro  
130                    135                    140

Leu Val Asn Pro Tyr Lys Ala Ser Glu Ile Asn Leu Thr Ala Ala Cys  
145                    150                    155                    160

Ile Val Ser Thr Thr Pro Leu Met Phe Thr Thr Pro Val Gln Gln Gln  
165                    170                    175

Lys Met Ala Asp Ile Tyr Arg Gln Cys Gln Arg Thr Ala Phe Gly Gly  
180                    185                    190

Asp Cys Phe Asn Tyr Leu Ser Ala Ala Ser Gly Trp Thr Ala Met Pro  
195                    200                    205

Leu Val Ile Val Glu Ala Asp Leu Asn Phe Tyr Asp Phe Cys Ala Leu  
210                    215                    220

Ile Pro Ile Leu Thr Gly Ala Asn Tyr Cys Phe Thr Asp Trp Gln Gly  
225                    230                    235                    240

Lys Glu Leu Thr Pro Glu Ser Thr Glu Val Val Ala Ser Pro Asn Pro  
245                    250                    255

Lys Leu His Ser Glu Ile Leu Ala Phe Leu Gln  
260                    265